

give the averages in the table, and to variations in the number of clear days in each month, the changes from year to year are very irregular, but on the whole there is a decided increase from 1870 to 1876. The sudden fall from 1873 to 1874 must be attributed, Mr. Hill thinks, to the greater diathermancy of the clear air at three of the stations in the former than in the latter year. It is worthy of note that 1873 was a very dry year at all the stations, but that 1874 was much wetter than usual except at Ajmere, where it was drier than 1873. At this station the solar radiation temperature shows a rise instead of a fall between 1873 and 1874.

With regard to the change of anemometer referred to by Mr. Blanford, Mr. Hill says that fortunately, in the present case, any other pair of stations, such as Madras and Vizagapatam, will do as well. With reference to the possible variation of the winter rain of Europe according to the supposed variation in the force of the anti-trade, Mr. Hill notices that the rainfall of London shows such a variation, though not very clearly. He adduces some figures in support of this.

In Mr. Hill's paper, vol. xvi., the word *minimum*, p. 505, second column, eighteenth line from bottom, *exact*, same column, third line from bottom, and *commutative*, p. 506, first column, fourth line from bottom, should be *maximum*, *excess*, and *commutative* respectively.

Mr. Hill also writes that the large double oscillation in the decennial period of rainfall in Southern India, pointed out by Mr. J. A. Broun, in *NATURE*, vol. xvi. p. 333, will probably be found to exist in other parts of the country, including the north. One of the longest continuous registers of rainfall in existence for any station in Upper India is that kept by the G. T. Survey Office at Mussoorie, in the Himalayas, lat. N. $30^{\circ} 28'$, long. E. $78^{\circ} 7'$, altitude 6,500 feet. The rain has been recorded since 1854, but only during the rainy season, May to October, inclusive; and the register down to 1873 has been already published by Mr. J. B. N. Hennessey, in the *Proc. R.S.*, vol. xxii. No. 152. Mr. Hennessey's table, extended down to the present year by means of a register kept by the Civil Surgeon, gives a general mean for the twenty-four years of $83\frac{1}{2}$ inches, and an absolute range of no less than 104 inches.

When the yearly rainfalls are arranged in series of two, three, &c., up to twelve years each, beyond which number it is impossible to extend the series without taking as representative the uncorrected falls of single years, it becomes evident that the great periodic oscillation that underlies the irregular variations must complete its cycle in from nine to twelve years, for the 9-, 10-, 11-, and 12-year series, all show a large amplitude of oscillation, and in the 11-year series the maximum and minimum occur at nearly opposite phases of the cycle. It is also evident that in the 6-year series the conditions are the same, the only difference being that the amplitude does not appear quite so great.

Calculating the coefficients of the equation of sines for the ten-and-a-half-year period, as Mr. Broun has done, we get for the variable part of the Mussoorie rainfall—

$$y = 11\frac{1}{4} \sin \theta + 14\frac{1}{2} \sin (\theta + 337^{\circ}).$$

This may be compared with the equations given in Mr. Broun's article for Madras and Trevandrum,¹ for in all these equations $\theta = 0$ for the years 1838·5, 1849, 1859·5, 1870, &c. The difference of the two angles, 259° and 337° , causes a difference of more than a year in the epochs of the maxima and minima of the secondary oscillations, otherwise there is a wonderful similarity between the formulæ for two such widely-separated stations as Mussoorie and Trevandrum.²

Mr. Hill thinks it most likely that the oscillation of the five-yearly period is either purely accidental or the effect of some cause not yet understood.

Mr. Archibald, writing on the subject of Cyclone Generation, directs attention to an exceedingly interesting article in the *Pioneer* of October 30, entitled "A Cyclone Study," in which the author brings forward some very strong additional proof in confirmation of the "condensation theory" held by Messrs. Eliot and Blanford as opposed to the "parallel wind theory" advocated by Drs. Hann and Thau, and Messrs. Meldrum and Willson. After giving a clear account of the main points of difference between the above theories, the writer then proceeds

to trace the history of the last cyclone in the Bay of Bengal, the Madras cyclone of May last, from its origin to its final disappearance, pointing out certain circumstances as giving strong support in favour of the condensation theory, and as completely disposing of the parallel wind theory—at all events as far as regards this particular cyclone.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The Mathematical Tripos' list this year contains ninety-four names. There are thirty-one classed as Wranglers, thirty as Senior Optimes, twenty-nine as Junior Optimes, and four *Ægrotant*. The Senior Wrangler is Mr. Ernest William Hobson, Scholar of Christ's College, eldest son of Mr. W. Hobson, proprietor and editor of the *Derbyshire Advertiser*. He was educated at Derby School, and in 1874 obtained an open scholarship at Christ's College. During his undergraduate career he obtained the first place among the students in the college examinations in mathematics. His college tutor was Mr. Peile, and his private tutor Mr. E. J. Routh, of St. Peter's College. Next to him are Mr. John Edward Aloysius Steggall, scholar of Trinity College, and Mr. Christopher Graham, scholar of Caius.

During the present term three courses of lectures on chemistry will be delivered. A general course by Mr. Main at St. John's College; a course by Mr. Lewis at Downing College; and a course on the non-metallic elements by Mr. Pattison Muir at Caius College.

MUNICH.—The university is becoming in point of numbers one of the foremost in Germany. The calendar for the present year shows an attendance of 1,360, of whom 1,014 are from Bavaria and 346 from other countries. In the theological faculty there are 82, in the legal 387, in the medical 341, in the philosophical (history, philology, &c.) 246, (science) 151, together with 136 pharmaceutical chemists, and 17 in forestry and agriculture. The corps of instructors numbers 114. The university, although but fifty-two years old, has been well supported by the State, and possesses a large variety of laboratories, cabinets, &c., and a library of 20,000 volumes.

SOCIETIES AND ACADEMIES

LONDON

Royal Astronomical Society, January 11.—Dr. Huggins, F.R.S., in the chair.—A paper by Mr. W. F. Denning on suspected repetitions or second outbursts from radiant points, and on the long duration of meteor showers, was read, showing that a radiant in some cases continues active during three or four months, and sometimes a second outburst occurs after an interval of six months, so that meteors may be seen coming from the same radiant at opposite sides of the earth's orbit. Capt. Tupman commented on this paper at some length, and pointed out some of the difficulties these conclusions presented.—Dr. Wentworth Erck read a paper on a combined position and setting circle, rendering the declination circle unnecessary on large Newtonian equatorials. He also showed a small and singularly portable equatorial mounting, and read a note on a spectroscope made by Mr. Grubb for Prof. Young, showing certain improvements. Mr. John Browning admired the ingenuity of these, and explained which of them were new and which were not.—Mr. A. A. Common read a note on the satellites of Mars and Saturn.—A note was read describing the failure of the Melbourne telescope to deal with the satellites of Mars.—Mr. S. Waters read a paper on the distribution of the fixed stars in space.—Mr. Christie read a paper on specular reflection from Venus, the purport of which was that his recent observations of the planet with the polarising eye-piece emphatically corroborated those made in 1876. By means of this eye-piece the light of the disc is gradually reduced; and he found in every examination that the last part of the disc to disappear was situated at a point which was found by calculation to coincide with the point indicated by the theory of specular reflection, thus confirming Mr. Brett's original description of the phenomenon. Mr. Christie had the assistance of Capt. Tupman in his recent observations. Mr. Neison suggested certain other explanations of the appearances described, and after further discussion the meeting adjourned.

Zoological Society, January 15.—R. Hudson, F.R.S., vice-president, in the chair.—A communication was read from Mr.

¹ Viz.: $y = 5\frac{1}{4} \sin (\theta + 50^{\circ}) + 4\frac{1}{2} \sin (\theta + 252^{\circ})$, and $y = 5\frac{1}{2} \sin (\theta - 17^{\circ}) + 8\frac{1}{2} \sin (\theta + 259^{\circ})$.

² The above equation for Mussoorie gives the maxima in 1860·3, 1870·8, &c., and the minima in 1857·2, 1867·7, &c. The first term alone would give the maxima in 1860·1, 1870·6, &c., and the minima in 1855·9, 1866·4, 1876·9, &c.

Andrew Anderson, F.Z.S., containing some corrections and additions to a former paper of his on the raptorial birds of the north-west provinces, read before the Society on March 21, 1876.—A communication was read from Mr. F. Moore, F.Z.S., containing a revision of the genera and species of European and Asiatic lepidoptera belonging to the family Lithosiidae. The author characterised thirty-eight genera in this memoir, and gave the descriptions of eighty new species.—Mr. A. Boucard, C.M.Z.S., read a paper in which he gave a list of the birds he had collected during a recent expedition to Costa Rica. The number of birds collected during his five months' stay was about one thousand in number, representing 250 species, amongst which were two new to science (*Zonotrichia boucardi* and *Sapphirina boucardi* of Mulsant) and many others of great rarity.—Two papers were read by Mr. G. French Angas. The first contained descriptions of seven new species of land shells recently collected in Costa Rica by M. A. Boucard. The second contained the description of a new species of *Latiaxis* from an unknown locality, proposed to be called *L. elegans*.—A communication was read from Dr. H. Burmeister, containing notes on *Conurus hilaris* and other parrots of the Argentine Republic.—A communication was read from the Count Salvadori, C.M.Z.S., in which an account was given of the birds collected during the voyage of H.M.S. *Challenger*, at Ternate, Amboyna, Banda, the Ké Islands, and the Aru Islands.—Prof. Garrod, F.R.S., read a paper on certain points in the anatomy of the Momotidae, in which he adduced facts substantiating their affinities with the Todidae, Alcedinidae, and other Piciformes. The second paper described the extraordinary structure of the gizzard of the Fijian Fruit Pigeon (*Carpophaga latraus*), in connection with the fruit on which it feeds, that of *Oncocarpus vitiensis*.—A communication was read from Mr. Edgar A. Smith, F.Z.S., containing the description of a new species of *Helix* from Japan, which he proposed to call *Helix (Camenia) congener*.—A communication was read from the Marquis of Tweeddale, F.R.S., containing an account of a collection of birds made by Mr. A. H. Everett in the Philippine Islands of Dinagat, Bazar, Nipak, and Sakeryok. Six new species were found in this collection and were named *Ceyx argentata*, *Hypothymis celestis*, *Mixornis capitalis*, *Dicaeum schistaceum*, *D. everetti*, and *Prionochilus olivaceus*.—A second paper by the Marquis of Tweeddale gave the description of a new genus and species of bird from the Philippine Island of Negros, for which the name *Dasyrotapha speciosa* was proposed.

Photographic Society, January 8.—James Glaisher, F.R.S., president, in the chair.—Papers were read by Capt. Abney, F.R.S., on the theory of the destruction of the undeveloped photographic image; by Edward Viles, on the production of enlarged photographs of microscopic objects; and by Edwin Cocking, "stray thoughts on the exhibition."—Capt. Abney in his paper stated the result of experiments undertaken to ascertain the cause of the fading away of the undeveloped image on dry plates by long keeping after exposure. Films of pure silver iodide, and of pure silver bromide, after exposure, were washed with potassium permanganate, potassium bichromate, and chromic acid; with the silver iodide salt, all destroyed the image, with the silver bromide salt the last two oxidising agents alone were effective. If this destruction of the image was caused by oxidation of the silver atom, it should also be oxidised by ozone—which experiments showed was the case. Capt. Abney then assumes that the effect of time on the image on a dry plate is to oxidise an atom of each of the molecules forming the image.

Institution of Civil Engineers, January 15.—The newly-elected president, Mr. John Frederic Bateman, F.R.S.S.L. and E., delivered an inaugural address. After a passing allusion to the growth of the Institution, which at the end of 1844 numbered only 552 of all classes, now increased to 3,189, reference was made to some of the addresses of the eighteen gentlemen who had previously occupied the presidential chair, mainly for the purposes of comparison. Proceeding to matters more personal to every member of the Institution, the President urged that engineering was but, in fact, the embodiment of practical wisdom; or, in the words of Bacon, "the conjunction of contemplation and action."

EDINBURGH

Royal Society, January 7.—Bishop Cotterill, vice-president, in the chair.—Prof. Blackie read a paper on Mr. Gladstone's theory of colour-sense in Homer, which he completely refuted. A discussion followed, in which Principal Sir Alexander Grant,

Bart., the Rev. Dr. Cazenove, Prof. Fleeming Jenkin, Dr. Donaldson, and others took part.—Prof. Tait postponed his paper on the intensity of currents required to work the telephone but mentioned that Mr. James Blyth had obtained good results with telephones in which he had employed discs of copper-wood vulcanised india-rubber paper, instead of the usual iron ones.—Prof. Tait also laid on the table a double mouthed-piece horn for producing chords by two performers on the same instrument.

VIENNA

Imperial Academy of Sciences, November 16, 1877.—On ice in the Danube in Lower Austria, in the winter 1876-77, by the Minister of the Interior.—Researches on the consciousness of place and its relation to the conception of space, by M. Stricker.—On the temperature of Vienna according to 100 years' observations, by M. Hann.—On the phanerogam flora of the Hawaii Islands, by M. Reichardt.

November 22, 1877.—On a partial differential equation of the first order, by M. Hocevar. The laws of the individuality of the planets of our solar system; attempt to establish a general theory, by M. Lehmann.

December 6, 1877.—The velocity of propagation of spark waves, by MM. Mach, Tumirz, and Kögler.—On the application of Doppler's principle to the progressive motion of luminous gas molecules, by M. Pfäundler.—On some problems of the theory of elastic reaction, and on a new method of observing vibrations by reading of mirrors, without loading the vibrating body with a mirror of considerable size, by M. Boltzmann.—Determination of surfaces any of whose parts, from two fixed points, are projected through cones the apertures of which are in a given proportion, by M. Weyr.—On mononitrobenzocatechin, by M. Benedikt.—Size and position of the optical axes of elasticity in gypsum, by M. von Lang.—On the orbit of the planet Laurentia (162), by M. Zelbr.

PARIS

Academy of Sciences, January 21.—M. Daubrée in the chair.—On account of the death of MM. Becquerel and Regnault, the séance was adjourned. The funeral of M. Becquerel took place the same day, that of M. Regnault next day. Discourses on the former were pronounced by MM. Fizeau and Daubrée; on the latter by MM. Debray, Jamin, Daubrée, and Laboulaye. [These are reported in the *Comptes Rendus* for the week.]

CONTENTS

PAGE

TAIT'S "THERMODYNAMICS." By Prof. J. CLERK MAXWELL, F.R.S.	257
WOLF'S HISTORY OF ASTRONOMY. By J. R. HIND, F.R.S.	259
OUR BOOK SHELF:—	
Capron's "Photographic Spectra. 136 Photographs of Metallic, Gaseous, and other Spectra printed by the Permanent Autotype Process"	259
LETTERS TO THE EDITOR:—	
Sun-spots and Terrestrial Magnetism.—B. G. JENKINS	259
On a Means for Converting the Heat Motion Possessed by Matter at Normal Temperature into Work.—JOHN AITKEN	260
No Butterflies in Iceland.—Prof. ALFRED NEWTON, F.R.S.	260
On some Peculiar Points in the Insect-Fauna of Chili.—ROBERT MCLACHLAN	260
The Radiometer and its Lessons.—Prof. G. JOHNSTONE STONEY, F.R.S.	261
A Double Rainbow.—THOMAS NOYE	262
SCIENCE IN TRAINING COLLEGES	262
SUN-SPOTS AND TERRESTRIAL MAGNETISM. By JOHN ALLAN BROWN, F.R.S.	262
HENRI VICTOR REGNAULT	263
THE ORIGIN OF A LIMESTONE ROCK. By Prof. W. C. WILLIAMSON, F.R.S.	265
THE LIQUEFACTION OF THE GASES (With Illustrations)	265
OUR ASTRONOMICAL COLUMN:—	
The Royal Observatory, Cape of Good Hope	269
The Total Solar Eclipse of July 29	269
CHEMICAL NOTES:—	
Temperature of Flames	269
Starch in Plants	269
Sipylite, a New Mineral Containing Niobium	269
Molybdenum	270
Relations between the Volumes of Silver Salts	270
Ornithuric Acid	270
Distillation of Organic Liquids by Means of Steam	270
GEOGRAPHICAL NOTES:—	
Early African Explorer	270
African Exploration	270
Mr Stanley	270
Berlin Geographical Society	271
Australia	271
Arctic Exploration	271
Canada	271
NOTES	271
RAINFALL IN INDIA	273
UNIVERSITY AND EDUCATIONAL INTELLIGENCE	275
SOCIETIES AND ACADEMIES	275